Errors of the middle observation :—

$$\delta\lambda = -8'' \qquad \delta\beta = -2''.$$

Ephemeris for Berlin Midnight

1885	App. R.A. h. m. s.	App. Decl. ° ′	Log. Δ	Brightness
Dec. 20 ...	23 59 57 ...	+20 43·1 ...	0·0837 ...	1·4
22 ...	56 49 ...	44·3		
24 ...	53 52 ...	46·2 ...	0·0844 ...	1·5
26 ...	51 5 ...	49·0		
28 ...	48 29 ...	52·6 ...	0·0849 ...	1·6

The brightness on December 1 is taken as unity. The above elements differ considerably from those published by Dr. S. Oppenheim in the *Vienna Circular*, No. lvi., but appear to represent the observations better.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *DECEMBER* 20–26

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on December 20

Sun rises, 8h. 5m. ; souths, 11h. 57m. 59·2s. ; sets, 15h. 50m. ; decl. on meridian, 23° 27′ S. : Sidereal Time at Sunset, 21h. 48m.

Moon (Full on Dec. 21) rises, 15h. 17m. ; souths, 23h. 5m. ; sets, 6h. 58m.* ; decl. on meridian, 17° 48′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	7 36 ...	11 45 ...	15 54 ...	20 58 S.
Venus ...	10 47 ...	15 17 ...	19 47 ...	17 41 S.
Mars ...	22 46* ...	5 25 ...	12 4 ...	7 2 N.
Jupiter ...	0 22 ...	6 23 ...	12 24 ...	0 38 S.
Saturn ...	16 19* ...	0 28 ...	8 37 ...	22 29 N.

* Indicates that the rising is that of the preceding and the setting that of the following day.

Occultations of Stars by the Moon

Dec.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
20 ...	γ Tauri ...	... 4 ...	4 11	near approach	44 —
20 ...	B.A.C. 1526	... 6 ...	17 6	near approach	151 —
21 ...	111 Tauri...	... 5½ ...	5 6 ...	5 56 ...	113 325
21 ...	117 Tauri...	... 6 ...	6 35 ...	7 6 ...	77 353
21 ...	B.A.C. 1930	... 6½ ...	17 46 ...	18 37 ...	38 253
25 ...	ξ Leonis ...	... 6 ...	3 55 ...	5 5 ...	80 276
26 ...	48 Leonis ...	... 6 ...	6 50 ...	7 48 ...	123 258

Phenomena of Jupiter's Satellites

Dec.	h. m.		Dec.	h. m.	
21 ...	1 35	II. occ. reap.	22 ...	5 54	I. tr. egr.
21 ...	5 17	I. ecl. disap.	22 ...	6 30	III. occ. reap.
22 ...	1 34	III. ecl. reap.	23 ...	3 14	I. occ. reap.
22 ...	3 35	III. occ. disap.	24 ...	0 22	I. tr. egr.
22 ...	3 38	I. tr. ing.	26 ...	7 11	II. tr. ing.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Dec.	h.	
21 ...	— ...	Sun at greatest declination south ; shortest day in northern latitude.
22 ...	5 ...	Saturn in conjunction with and 3° 58′ north of the Moon.
26 ...	11 ...	Saturn in opposition to the Sun.

Variable Stars

Star	R.A. h. m. s.	Decl. ° ′		h. m.	
β Lyræ	18 45 50 ...	33 13·8 N. ...	Dec. 25,	0 0	*m*
R Lyræ	18 51 50 ...	43 47·7 N. ...	,, 26,		*m*
χ Cygni	19 46 9 ...	32 37·4 N. ...	,, 26,		*M*
η Aquilæ ...	19 46 37 ...	0 42·7 N. ...	,, 21,	17 0	*M*
δ Cephei ...	22 24 54 ...	57 49·6 N. ...	,, 23,	4 0	*M*
,,			,, 26,	23 0	*m*
R Andromedæ.	0 17 58 ...	37 56·4 N. ...	,, 23,		*M*
Algol	3 0 41 ...	40 30·7 N. ...	,, 22,	3 51	*m*
,,			,, 25,	0 40	*m*
ζ Geminorum...	6 57 17 ...	20 44·3 N. ...	,, 23,	19 0	*M*
δ Libræ	14 54 50 .	8 3·7 S. ...	,, 22,	19 5	*m*
,,			,, 25,	2 56	*m*

M signifies maximum ; *m* minimum.

Objects with Remarkable Spectra

Mr. O. T. Sherman, of Yale College Observatory, has recently called fresh attention to the spectra of γ Cassiopeiæ and β Lyræ, as he finds no fewer than seventeen bright lines in each. Both stars should therefore be examined as frequently and carefully as possible. β Lyræ is at minimum about midnight on Dec. 25.

There is an uncertainty about the ephemeris of R Andromedæ which renders observations of its brightness a matter of importance ; its spectrum, whilst resembling in several particulars that of the third type, possessing so many special characteristics, that it deserves the most careful attention directly the star has attained a sufficient magnitude.

THE RETURN OF THE LEONIDS IN 1885

BETWEEN November 5 and 13 inclusive we had densely overcast skies, so that no observations could be obtained here.

On November 14 weather improved, but it was not until the morning of the 15th that the clouds completely dispersed and enabled that uninterrupted view of the firmament which is so necessary to the successful recording of meteors. The three following nights were also brilliantly clear, though the severe frosts which occurred rendered open-air watching somewhat trying. I have summarised my results for the four mornings as follows :—

Date, 1885	Time of obs. a.m. h. h.	Actual duration of obs. h.	Meteors seen	Leonids	Radiant point ° °
Nov. 15 ...	3½ to 6 ...	2¼ ...	24 ...	4 ...	149 +21
16 ...	0¾ to 3 ...	2 ...	23 ...	0 ...	—
17 ...	0¾ to 4¾ ...	3½ ...	42 ...	6 ...	150 +22
18 ...	2¾ to 5¼ ...	2¼ ...	25 ...	1 ...	—
Nov. 15–18...	0¾ to 6 ...	10 ...	114 ...	11 ...	149½ +21½

Making certain allowances for the intervals occupied in registering the paths, &c., meteors fell at the rate of about 14 per hour for one observer. Of the total number seen 11 only belonged to the special shower of Leonids. The proportion of the latter to the meteors visible from all other streams was therefore as 1 to 10·4. Six of the Leonids appeared in Leo with much foreshortened tracks close to their radiant point, which admitted of very accurate determination. As usual, they left lines of phosphorescence which in several instances brightened most perceptibly about one or two seconds after the extinction of the nucleus. I have frequently noticed this after-glowing of the streaks which are so commonly generated by the swift meteors discharged from the radiants near the apex of the earth's way.

On the morning of the 15th the Leonid's furnished about two meteors per hour for one observer. On the 16th there was an apparent lull in the display, not one being observed. On the 17th there was a very distinct reappearance of the shower with the same relative intensity as on the 15th. On the 18th the shower had nearly become exhausted, for of 25 shooting-stars only one certainly could be assigned to the radiant in Leo.

It is extremely probable that the maximum took place, as it usually does, on the morning of the 14th, when unfortunately the sky was involved in clouds. But the observations now reported for the later nights of the display sufficiently prove there to have been a definite, though feeble, revival of the shower this year, and there can be no question that the Leonid meteor-orbit is continuous so far as our accumulating observations enable us to judge. Every November, as the earth crosses the node, meteors having the same radiant in the sickle of Leo are to be seen, and they exhibit all the characteristics typical of the Leonids during one of the major displays. There are doubtless some condensations in the orbit, giving rise to brighter showers in some years than in others, but a large number of further observations are required to determine the precise nature of these. There can be no doubt that there are certain occasions when fairly bright returns of these meteors pass wholly unobserved. Moonlight, cloudy weather, or the occurrence of a maximum in the daytime, may so much obliterate it as to induce entirely wrong impressions as to its comparative strength in successive years. We essentially require observers in widely different longitudes, and the continuity of annual records should be preserved as far as possible.

With regard to the display of the present year, the want of observations on November 12 and 13 will not allow us to form a safe judgment as to its character. Probably it has been below the average. As to the individual meteors recorded at this station, they were generally small, and, with one exception, need no comment. The brightest appeared at 5h. 3m. a.m. on November 15, and was estimated very nearly equal to Jupiter. Its path of 12° lay 5° south of β and γ Draconis, and it left a vivid streak there for about five seconds.

As to the numerous contemporary showers of this epoch, they are extremely interesting, and some of them were observed this year with unusual distinctness. In preceding years I have registered a considerable number of Taurids and Muscids at this epoch, but during my late observations not many were noticed. I was, however, watching a region of the heavens far removed from the radiant points of these showers—a fact which may in some measure explain the apparent paucity of their meteors. But on the 15th and 16th a few of the slow-moving Taurids were seen traversing long flights amongst the stars of Leo Minor and Ursa Major. At 2h. 20m. a.m. on November 16 one fell in a path of 17° slightly to the left, and very nearly parallel to the stars ζ and η of Ursa Major. It was brighter than Jupiter, and exhibited a small yellowish-white disk, varying in magnitude in a most curious manner. During its course the meteor appeared to halt and rekindle with increased impetus several times, and short trails of sparks were thrown off at the points of maximum brightness.

Below I give a summary of all the radiant points derived from my a.m. observations on November 15-18 last :—

No.	Radiant	No. of meteors	No.	Radiant	No. of meteors
	° °			° °	
1 ...	149½+21½ ...	11	7 ...	213+75 ...	8
2 ...	154 +41 ...	12	8 ...	157+74 ...	4
3 ...	166 +31 ...	10	9 ...	79+56 ...	6
4 ...	144 +50 ...	6	10 ...	73+42 ...	5
5 ...	125 +41 ...	6	11 ...	190+21 ...	3
6 ...	60 +28 ...	5	12 ...	100+41 ...	5

Nos. 2, 3, 4, and 5 are important. They severally furnish meteors of the swift streak-leaving class. No. 6 represents the centre of a few Taurids, and Nos. 7 and 8 are positions derived from slow meteors not very far from Polaris. Nos. 9 and 10 are a pair of sharply-defined radiants in Auriga, and No. 11 is an entirely new shower which I observed on the morning of the 17th and 18th. Only three of its meteors were recorded, but their paths intersect at a point, and I believe the position is reliable.

The radiant No. 2 at 154° + 41°, near μ Ursæ Majoris, is the best of all, and has often been seen in previous years. It is evidently the same as the "very active shower" described by me in NATURE, vol. xv. p. 158, as observed here from the point 155° + 36°, on November 20-28, 1876. It is also identical with the shower seen from 155° + 35° by Father Perry at Stonyhurst College Observatory on November 13-15, 1879 (*Monthly Notices*, January, 1880, p. 140). Not only in November, but in many other months, does this particular radiant point manifest itself. I have summarised the positions from September to December, though the shower is still sustained with equal definiteness until May :—

Radiant	Epoch	Observer or authority
° °		
155+41 ...	Sept. 8–October ...	D. From Zezioli's obs.
156+41 ...	September 15–16 ...	D. Obs. in 1877
153+42 ...	October 16	D. Obs. in 1877
152+38 ...	October 14	D. Obs. in 1879
160+40 ...	November 7, 1869 ...	Tupman (estimated)
149+38 ...	November 1–15, 1872	D. From Italian obs.
157+46 ...	November 11–15 ...	Denza
155+35 ...	November 13–15 ...	Perry. Obs. in 1879
154+41 ...	November 14–17 ...	D. Obs. in 1885
155+36 ...	November 25–27 ...	D. Obs. in 1876
154+39 ...	December 6–7	Backhouse
160+40 ...	December 8–9	Backhouse
152+43 ...	December 9–12... ...	D. From various foreign obs.
149+45 ...	December 9	Schiaparelli and Zezioli

The positions marked "D." are those resulting from my own observations or reductions. The two radiants at 160° + 40°, by Tupman and Backhouse, may possibly relate to another bordering shower, bnt the position is very close to the mean of all at

154°·4 + 40°·4.

This is a shower (or series of showers) which eminently stands in need of further investigation. The radiant appears to be stationary and continuous for a long period. The shower at 166° + 31°, 10° north of δ Leonis, which I detected this year, has escaped me before, though it was seen at Stonyhurst in 1879, November 13-15, at 166° + 22°. As to position No. 5 in my present list, I saw that well on November 12, 1877, at 125° + 40°. With reference to the radiant No. 4 at 144° + 50°, close to θ Ursæ, I have not recognised it in November until this year, but in October last I determined a good radiant at 143° + 49° from meteors seen in the morning sky.

These circum-Leonid streams reappear with more or less distinctness every year, and their radiant points are sharply defined. It would be well to thoroughly study the durations of several of them, now that their positions have been ascertained with a considerable degree of accuracy by several observers.

Bristol, November 19 WILLIAM F. DENNING

NOTES FROM THE OTAGO UNIVERSITY MUSEUM

VII.—*On some Models Illustrating Phyllotaxis*

PHYLLOTAXIS is a subject which presents special difficulties to the student when illustrated only by diagrams and by actual specimens of plants. With these aids alone it

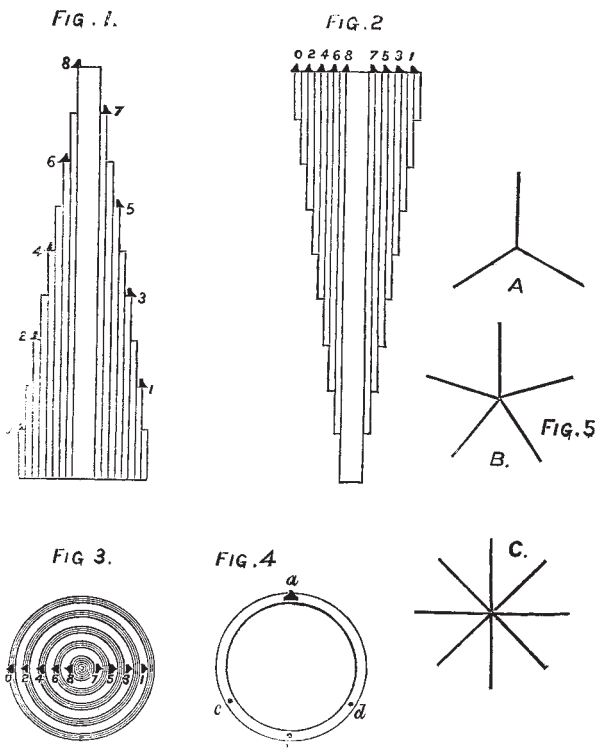

FIG. 1.—Vertical section of model, one-eighth actual size; 0-1, the leaf knobs.
FIG. 2.—The same, telescoped, the upper edges of all the cylinders being brought to one level.
FIG. 3.—The same, telescoped, and viewed from above.
FIG. 4.—One of the cylinders from above: *a*, the fixed leaf-knob; *b*, *c*, *d*, holes for the insertion of movable knobs.
FIG. 5.—Wire stars to represent orthostichies: A, for divergence of one-third; B, for two-fifths; C, for three-eighths.

entails an expenditure of time, out of all proportion to the importance of the subject, to make clear in a lecture or demonstration the principles of leaf-arrangement and the mode of construction of the leaf-diagram.

I find the model about to be described of great assistance in explaining these matters. It consists of a "nest" of nine con-